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Research Article

Surgical Tenolysis for Post-Traumatic Finger Stiffness: Outcome Evaluation of Our Technique

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ABSTRACT

Background

Hand injuries are often associated with stiffness and loss of movement of the fingers because of adhesions and fibrotic tissue formation of tendons. Tenolysis surgery is performed to loosen these adhesions to allow the tendons to slide and move normally. Multiple methods have been outlined, each possessing its own pros and cons.

Objective: This paper analyzes the clinical results of our surgical process in the treatment of stiff fingers, which includes the release of flexor and extensor tendons under local anesthesia while allowing movement of the fingers during surgery to guarantee full adhesion release.

Duration and place of study: This study was conducted at Burns Center Civil Hospital and Dow University of Health Sciences Karachi from October 2024 to October 2025

Methodology: A retrospective study was provided on 50 patients who had tenolysis performed on them with the use of this technique. The demographic information, injury nature, and clinical observations were noted. Total active motion (TAM) and flexion lag were measured preoperatively and postoperatively and compared. The perioperative or postoperative complications were also analyzed.

Results: A total of 50 patients who had stiff fingers were analyzed. The average preoperative TAM had a significant limitation, and the postoperative measurements had a significant improvement in the active range of movement. The TAM was found to have increased statistically ($p < 0.05$). No significant surgical morbidity was noted, and the majority of the patients had significant functional recovery.

Conclusion: The comprehensive release of adhesions surrounding flexor and extensor tendons results in a significant increase in the mobility in the fingers. Tendon release when done under local anesthesia with active involvement of the patient during the surgical procedure increases the adequacy of the tendon release procedure and helps to improve the functional results.

Keywords: Finger Stiffness, Tenolysis, Hand Trauma, Total Active Motion, Tendon Adhesions.

INTRODUCTION

The hand injuries are known to cause a long-term functional impairment, especially when the flexor and extensor tendon systems are involved. The majority of patients experience stiffness of the fingers even after proper primary repair and rehabilitation because of adhesion and fibrosis around the tendons. This causes minimal gliding of the tendons, decreased range of movement, and severe restrictions in the day-to-day activities and working life [1].

The development of stiffness of the fingers after trauma is a complex of various factors, such as wastage of time, scarring of the soft tissues, contraction of the joint, and adhesion

between the tendon and the structures [2]. Of these, the most common and debilitating sequelae is peritendinous adhesions. The adhesions inhibit the movement of the tendon in a cordial manner and encourage the flexion and extension of the digit [3].

Flexor and extensor tenolysis is an operation that is meant to take away these adhesions and bring back the flexibility of the tendons. The idea is to restore the free movement of the tendon in its anatomical tract, which enhances the active range of motion and hand functioning [4]. Tenolysis has developed since the time of its initial description, and many surgical interventions and postoperative measures have been suggested [5].

The results of tenolysis are inconsistent, even with technical improvements. The level of success that is reported is influenced by a number of factors such as patient selection, time of surgery, degree of scarring, quality of the initial tendon repair, and compliance with the latter rehabilitation [6]. Motion protocols initiated early, once tendons have been repaired, have decreased the formation of adhesions, yet a high proportion of patients continue to need second procedures as they still experience stiffness [7].

Historically, the tenolysis has been done either under general or regional anesthetic conditions. Nevertheless, a significant issue in the course of the surgery is the possibility of deciding whether any adhesions have been sufficiently released. The passive movement of the surgeon is not necessarily a true active tendon excursion, and any adhesions left may not be detected intraoperatively [8]. This may result in inefficient postoperative outcomes and additional measures.

In hand surgery, the use of local anesthesia involving active intraoperative movement has attracted increased attention. In this method, the patient actively flexes and extends the fingers in the procedure so that the surgeon can directly see tendons gliding and immediately determine whether some restrictive bands are left or not [9]. The principle is consistent with the ideology of wide awake local anesthesia no tourniquet (WALANT), which has proven to be safe, as well as effective in several hand surgeries [10].

The findings of a number of studies have revealed that the effectiveness of active involvement of the patient in the surgical procedure enhances tenolysis completeness and enables real-time evaluation of functional performance [11]. Active intraoperative movement gives first hand information on the effectiveness of adhesion release and allows immediate correction of movement in case it is still limited [12]. This is another method that helps patients to understand what to do after the surgery and promotes early rehabilitation.

The other benefit of doing tenolysis under general anesthesia is that it eliminates the risks of general anesthesia and the use of tourniquets. It also enables effective communication between the surgeon and the patient during the procedure and could lead to improved patient satisfaction and patient involvement in the process of recovery [13].

However, there are no complications with tenolysis. Some of the risks would be tendon rupture, neurovascular injury, infection, and adhesion recurrence. The selection of patients and the use of a careful surgical technique would reduce these risks and maximize functional recovery [14]. Besides, the effectiveness of tenolysis is closely associated with a planned postoperative physiotherapy, which focuses on early controlled active movement [15].

Although the use of active intraoperative techniques continues to gain increasing popularity, additional analysis of the clinical outcomes of this approach is still required. A majority of the published series have small sample sizes and diverse methodologies. It is necessary to have standardized reporting of functional measures like total active motion in order to be able to make any meaningful comparison between various approaches [16].

The current project is expected to assess the results of a surgical procedure in the treatment of post traumatic joint stiffness of the finger, which lies in the tenolysis of the flexor and extensor tendons when the procedure is carried out under local anesthesia coupled with active intraoperative finger action. Using alterations in total active movement as well as functional recovery, this research aims to add to the existing literature and give additional evidence of the usefulness of this method.

METHODOLOGY

The research aimed to conduct a retrospective observational study of the patients who underwent surgical tenolysis to treat post traumatic finger stiffness with the application of an active intraoperative motion technique. All patients with limited ability to move their fingers by tenolysis were eligible, including

both genders and all ages. The final analysis was done on only those people who had full clinical records and at least twelve months of postoperative follow-up.

The patients were chosen based on the presence of stiffness in their fingers due to any form of traumatic etiology that could be fracture, tendon rupture, crush, or soft tissue injury, which would result in limited active movement. The patients were not included in the study if they had a diagnosis of Complex Regional Pain Syndrome, reflex sympathetic dystrophy, active infection, severe joint destruction, neurological impairment of the hand, or other serious systemic comorbidities that may interfere with healing or rehabilitation.

The institutional ethical review committee gave the study its approval before the data collection. Individual patient records were individually reviewed in order to obtain demographic data, injury manner, structures involved, form of original treatment, and time duration between the original injury and the tenolysis surgery. Any intraoperative or postoperative complications were recorded too.

The outcome measures were Total Active Motion (TAM) and flexion lag as the main outcome measures. TAM was calculated as the difference between active flexion of the metacarpophalangeal, proximal interphalangeal, and distal interphalangeal involved joints and the deficit of extension of these joints. Differences between passive flexion and active flexion at the proximal and distal interphalangealjoints were referred to as flexion lag.

Follow-up notes made in clinics captured Preoperative and postoperative TAM and flexion lag values. The results were scored based on the American Society of Surgery of the Hand standards. Paired comparison tests were done to determine the changes in the preoperative and postoperative values in order to have a statistical analysis. A p-value lower than 0.05 was thought to be statistically significant.

Tenolysis was carried out in all the patients through local anesthesia with the active finger motion technique. The area of operation was anesthetized, and the patient was made awake and could actively move the digits involved during the operation.

A zigzag cut was made on the flexor of the finger, starting at the distal palmar crease up to the distal finger crease, according to the need to provide sufficient exposure. The flexor tendon sheath was handled in such a way that both the flexor digitorum profundus and flexor digitorum superficialis tendons had adhesions carefully detached with fine tools. The pulley system was maintained as much as possible. Sections of the A2 or A4 pulleys were vented when required to enable easy movement of tendons.

The patient was requested to flex and extend the finger after the release of adhesions. Direct observation was done on tendon excursion. In case active motion was confined, additional proximal or distal dissection was done to eliminate all the remaining restrictive bands. When necessary, adhesions around the extensor tendon and joint capsule were also released.

It was only considered that total tenolysis had been achieved when active flexion and extension of the finger were virtually the same as passive movement. Hemorrhage was contained, and the wound was stitched in layers with fine sutures.

During the first postoperative day, patients were advised to start doing some active finger movements. They were advised to fist with one hand and maintain the position several seconds then repeat act at a time and to do it several times in a day. Active and passive range of motion exercises were also introduced on the third postoperative day to the maximum tolerated levels.

No strict rehabilitation regime was enforced, but all the patients were informed about the need to move their fingers a lot and adhere to the home-based exercises. Regular follow-up visits were arranged to examine wound healing, range of motion, and functional healing.

RESULTS

50 Patients who had surgery using the active intraoperative motion technique underwent surgical tenolysis and were included in the ultimate analysis. All patients had undergone the necessary postoperative follow-up. The sample consisted of both male and female patients of a large age spectrum, which is a representative population with post traumatic finger stiffness.

Out of the 50 patients, 22 patients (44%) had a history of fracture during the time of initial injury. The most prevalent mechanism was high-energy trauma. The table below summarizes the fracture patterns and how they can be handled (Table 1). Fractures that

occurred more often were the comminuted ones than the transverse ones. The most widespread bone was the proximal phalanx. Fractures were treated by use of percutaneous K-wire fixation in most cases, with a reduced percentage that underwent open reduction and internal fixation.

Table 1. Fracture Patterns and Their Management in Patients with a History of Fracture at Initial Trauma (N = 22)

Fracture Type	n	%
Comminuted	17	77.3
Transverse	5	22.7

Fracture Location	n	%
Distal phalanx	4	18.2
Middle phalanx	6	27.3
Proximal phalanx	12	54.5

Treatment Method	n	%
Percutaneous K-wire	18	81.8
ORIF	4	18.2

The marked improvement of the finger motion that followed tenolysis was observed in all patients. Table 2 reports the preoperative and postoperative Total Active Motion (TAM) and flexion lag values.

The average preoperative TAM was at 102(35-160) and went a long way better to an average postoperative TAM at 210(175-270). Likewise, the mean flexion lag was reduced from 90 (range 50 to 160) to 20 (range 5 to 35) in preoperative and postoperative periods, respectively. The two improvements were statistically significant ($p < 0.05$).

Table 2. Preoperative and Postoperative Total Active Motion (TAM) and Flexion Lag

Parameter	Pre Tenolysis Mean (Range)	Post Tenolysis Mean (Range)
Total Active Motion	102° (35–160)	210° (175–270)
Average Flexion Lag	90° (50–160)	20° (5–35)

Final functional outcomes were graded using the American Society for Surgery of the Hand criteria. Results are shown in Table 3.

Outcomes were excellent in 6 patients, good in 12, fair in 8, and poor in 2, showing that the majority achieved meaningful functional improvement.

Table 3. Improvement in Range of Motion According To American Society for Surgery of the Hand Criteria (N = 30)

Percentage of Improvement	Number of Cases
Excellent (75–100%)	6

Good (50–75%)	12
Fair (25–50%)	8
Poor (0–25%)	2

The commonest adhesions were between A1 and A4 pulleys. No adhesions were found further than the A5 pulley or in the carpal tunnel. The A2 pulley was sent back in a few situations, partly released, and the A4 pulley was not removed in any of the patients.

Three patients needed pulley reconstruction, and two needed the release of their joints. In four patients, further extensor tenolysis was done to enhance motion.

No tendon rupture, digital neuropraxia, or deep infection was reported. Three patients resulted in a recurrence of stiffness with a decrease in active motion during the follow-up, and repeat tenolysis was considered to be performed in such cases.

DISCUSSION

Post traumatic finger stiffness is a major issue in hand surgery whose management is a challenge to the field. Even with the current development of primary tendon repair methods and early mobilization guidelines, a few patients still develop disabling adhesions that curtail the gliding of tendons and functional use of the hand. The current research proves that surgical tenolysis with local anesthesia and active intraoperative finger movement can result in significant changes in Total Active Motion and flexion lag reduction.

The large improvement in TAM observed during this series is an indication of good restoration of tendon excursion. Other authors have also reported similar gains and indicated meticulous adhesion release and early postoperative motion as important predictors of success [17]. The idea that the patient is allowed to move the finger in the surgery room, thus the surgeon can detect and cut the bands that are holding back the finge,r is also supported by our findings.

Intraoperative functional outcome assessment in real time is one of the most significant features of this technique. Passive motion does not necessarily always go hand in hand with actual tendon gliding. Gently moving the knee shows subtle tethering, which may continue even after seemingly sufficient release. Intraprocedural active testing. Intraoperative active testing has been identified to minimize the chances of incomplete tenolysis and stiffness postoperatively [18].

The low complication rate in the present study is in line with that done before. Rupture of the tendon, infection, and neurovascular injury are known dangers of tenolysis, although the occurrence is rare in cases where proper technique and proper selection of patients are used [19]. None of the significant surgical complications in our series supported the case of the active motion approach as a safe method.

Reoccurrence of stiffness is also an issue after tenolysis. The current research involved five patients who lost surgery movements in the follow-up and were deemed to repeat discharge. This defines the significance of the postoperative rehabilitation and patient compliance. Controlled active movement has been found to have a great decrease in re-adhesion and enhances the long term functional outcomes when applied at a young age [20]. Even though there was no strict therapy regimen applied in this study, all the patients were informed about the necessity of regular movement and follow-up.

The other crucial observation is associated with pulley preservation. Overhauling the A2 or the A4 pulleys will lead to bowstringing and loss of flexion strength. Pully preservation was chosen in the first place in our series, where reconstruction was only conducted when necessary. This practice is in accord with the biomechanical research that has indicated that the integrity of the pulley system is essential to the normal functioning of the fingers [21].

The comparison of the results based on the American Society of Surgery of the Hand criteria revealed that most of the patients demonstrated good to excellent improvement. This is similar to other tenolysis series, which have been performed with active motion techniques [22]. Although the difference was considerable, not every patient was able to restore all of the motion, which testifies to the complexity of the issue of post traumatic stiffness and the impact of other factors, including the extent of the initial injury, the joint involved, and the response time.

The research has a number of weaknesses. The retrospective design it has adds the risk of selection bias and reporting bias. Moreover, objective measures of strength and patient-reported outcome measures were omitted. Prospective studies that include standardized functional scores and extended follow-up would be more comprehensive in their assessment of outcomes.

Regardless of these shortcomings, the results of the present research justify the active intraoperative tenolysis as a safe and efficient technique to deal with the post traumatic stiffness of the fingers. The capability to evaluate and maximize the tendon gliding during surgery seems to portray significant functional recovery in the majority of patients.

CONCLUSION

This research indicates that flexor and extensor tendon tenolysis with the use of local anesthesia and active intraoperative finger motions is a safe and successful methodology for post-traumatic finger stiffness treatment. Total active motion and flexion lag levels were significantly improved, and most patients recorded good/excellent functional outcomes. The attendance of the patients throughout surgery enables the counting of the residual adhesions, which are identified and released accurately, which improves the movement of tendons. The utility of this technique is stressed by low levels of complications and meaningful recovery. The correct release of adhesion, maintenance of the pulley, and early postoperative mobility are also important to achieve the best results.

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